THURSDAY, JULY 30, 1874

JOSEPH PRIESTLEY

DURING the present week the centenary of the birth of Modern Chemistry, as the discovery of oxygen on August 1, 1774, may justly be called, is being celebrated both in this country at Birmingham and Leeds, and in America at Northumberland, Pennsylvania; we have therefore thought it would be acceptable to our readers to be reminded of the principal events in the life of the author of this all-important discovery.

Joseph Priestley was born on March 13, 1733, at Fieldhead, near Leeds. At the age of six years he lost his mother, and his education was superintended by Mrs. Keighley, his aunt, a woman apparently of unusually wide sympathies. At an early age young Priestley distinguished himself at school by his great aptitude for learning languages; he was familiar with Chaldean, Syriac, and Arabic, and without the aid of a master acquired some knowledge of German, French, and Italian. A pupil of Maclaurin taught him mathematics. He took great interest in theological controversies, and his aunt's tastes provided him with many opportunities of gratifying his liking in this matter. Having studied for the Dissenting ministry, he was called to be minister of a small Unitarian congregation at Needham Market, in Suffolk, in 1755. Here he remained until 1758, when he went to occupy a similar post at Nantwich, in Cheshire. Here he opened a school, and by dint of rigid economy was able to buy some physical apparatus, with which he made, to his young pupils, a series of experiments that drew upon him the notice of the authorities of the Warrington Academy, so well known in connection with the name of Aikin. In 1761 he went to this Academy to take Dr. Aikin's place as teacher of languages and literature, and soon after married the daughter of a Welsh ironmaster. While at Warrington he published a number of works on various subjects, including the "Theory of Language and Universal Language" (1762-68), "Essay on a Course of Liberal Education for Civil and Active Life" (1765), "Chart of Biography" (1765), Chart of History" (1769), &c. A visit which he made to London during this period gave him the opportunity of forming a lasting friendship with Franklin and Price. He communicated to the former his intention of writing a history of discoveries in the department of electricity; and not only did he receive from Franklin a warm approval of the scheme, but also all the books and memoirs he required; and before the end of the year, by dint of persevering work, the first volume was published, under the title of "The History of Electricity" (London, 1764, 4to). Three editions of this were published by 1775; but it bears evident marks of having been written in haste.

Previous to the publication of this work, in 1766, Priestley was chosen a Fellow of the Royal Society, and about the same time the University of Edinburgh conferred upon him the honorary degree of LL.D. In the same year as the above-mentioned work was published, Priestley left Warrington and became pastor of Mill-hill Chapel, in Leeds. While here he was much occupied with theological controversies, but by no means neglected his scientific studies, as about 1768 his attention was drawn to chemistry, the result being that in 1772 he communicated to the Royal Society a paper entitled "Observations on different kinds of Air," for which the Copley Medal was awarded to him.

Meantime, Priestley had received an offer to accompany Capt. Cook on his second expedition to the South Seas; this he accepted gladly, but received an intimation that his nomination had not been confirmed by the Board of Longitude on account of his advanced theological opinions. In 1773, however, at the recommendation of his friend Price, he was appointed librarian to the Earl of Shelburne (afterwards Marquis of Lansdowne) at a comparatively liberal salary. In the following year, he accompanied this nobleman into France, Germany, and the Low Countries. At Paris his scientific reputation easily procured him the acquaintanceship of well-known men of science. Besides his salary, Lord Shelburne allowed him expenses for a laboratory, and it was on Aug. 1, 1774, that he made the discovery which marks so important an epoch in the progress of chemical science, and the centenary of which is being celebrated both in England and in America during the present week. The discovery was that of oxygen gas, which he announced in his "Experiments and Observations on Air," the first volume of which was published in 1774.

For some unexplained reason, Priestley and Lord Shelburne parted in 1780, the latter covenanting to allow the former till his death a pension of 150*l*. Priestley then settled in Birmingham, to which he was attracted, no doubt, by the prospect of meeting with men of kindred scientific tastes. Here he was chosen pastor of one of the principal Dissenting churches, his friends subscribing to defray the expenses of his scientific experiments and his theological controversies, for he was regarded as one of the greatest controversialists of his age. His opinions both on ecclesiastical and political topics were much ahead of his age; but this is not the place to enlarge on this aspect of the character of this remarkable man. We may only mention that he was brought forward as a candidate for the French National Convention, and was nominated a French citizen, a title of which he was very proud. For his unconcealed liberality and advanced opinions he was doomed, however, to suffer, as the populace of Birmingham, roused to a state of blind fury by the partisans of Government, rushed to Priestley's house, July 14, 1791, and set fire to it, reducing it and nearly all it contained to ashes. However, as the result of an examination, Priestley subsequently received an indemnity of 2,000*l*. for this mad act, this sum being considerably increased by the liberality of his private friends.

Although no word of complaint escaped Priestley concerning this misfortune, it no doubt influenced him to a considerable extent in deciding him to quit his native land for republican America. After spending three years in a college at Hackney, as Professor of Chemistry and minister, he embarked on April 7, 1794, and fixed his residence at Northumberland, in Pennsylvania. Even here it was some time before he was allowed to remain at peace, as a spiteful rumour had been circulated that he was a secret agent of the French Republic. Here he lost his wife and

his youngest son, and here he himself died on Feb. 6, 1804.

Turning now from the external aspects of Priestley's life, let us consider the position he held as a philosopher and the influence that his discoveries had on the science of his time. The ever-memorable discovery of "dephlogisticated air" on Aug. 1, 1774, marks an epoch in the annals of chemistry with which the name of Dr. Joseph Priestley will be always associated. He obtained it by exposing a quantity of red precipitate of mercury to the action of the sun's rays concentrated upon it by a lens; the red precipitate was contained in a flask filled up with mercury and inserted in a basin containing the same metal. "I presently found," he says, "that by means of this lens air was expelled from it very readily. Having got several times as much as the bulk of my materials, I admitted water to it, and found that it was not imbibed by it; but what surprised me more than I can well express, was that a candle burned in this air with a remarkably vigorous flame, very much like that enlarged flame with which a candle burns in nitrous air exposed to iron or lead of sulphur; but, as I got nothing like this remarkable appearance from any kind of air besides this particular modification of nitrous air, and I knew no nitrous acid was used in the preparation of *mercurius calcinatus*, I was utterly at a loss how to account for it." He then goes on to show that red lead and nitre also afford oxygen at a red heat, and calls it, consistently with the theory of combustion which was then prevalent, *dephlogisticated air*, regarding it as common air deprived of phlogiston, and consequently possessed of a powerful affinity for that imaginary principle.

This discovery, however, though unquestionably brilliant, must not be allowed to eclipse those other numerous and valuable contributions to science with which this indefatigable worker enriched the stores of natural knowledge during a period ranging from 1768 to 1800. There are indeed few branches of natural science which did not reap some benefit, direct or indirect, from the discoveries of the experimenter whose memory we now recall.

On the 17th of August, 1771, Priestley enclosed a sprig of mint in air in which a taper had been allowed to burn out, and he found on the 27th of the month that the same air then permitted the combustion of another taper with perfect facility. Thus was the secret of vegetable respiration first made known. In the discoverer's own words: "This restoration of air I found depended upon the vegetating state of the plant; for though I kept a great number of the fresh leaves of mint in a small quantity of air in which candles had burned out, and changed them frequently for a long space of time, I could perceive no melioration in the state of the air." In pneumatic chemistry (of which the germs had been originated by Black, Mayow, Hooke, and Hales), Priestley found a new engine of research, and in his hands this Ὀργανον yielded vast results. His productions in pure chemistry are too well known to be discussed fully here, even did space permit. In addition to oxygen he discovered nitrous oxide (1776), sulphurous anhydride (1774), ammonia gas (1774), carbonic oxide and hydrochloric acid gas (1772): he was also the first to investigate the properties of nitric oxide. We may point to nitrous oxide *en passant* as one of the many instances in which pure science has furnished a substance of practical utility to man: the discoverer of "dephlogisticated nitrous air" little dreamt that the lapse of a century would see this substance used as an anæsthetic for the purposes of dentistry. The pneumatic and mercurial troughs, now indispensable parts of our laboratory "plant," were also bequeathed to us by the philosopher of Fieldhead. Although chemistry received the greater part of Priestley's attention, other branches of science, as before stated, received the benefit of his thoughts. Thus we find a work by him bearing the date 1772, entitled "The History and Present State of Discoveries relating to Vision, Light, and Colours," and we have already referred to his "History of Electricity." From a catalogue of Priestley's works, printed at the end ot his "Experiments and Observations relating to various branches of Natural Philosophy," we find that this extraordinary man was the author of no less than thirty-six volumes on various subjects; among others, the theory and practice of perspective, charts of history and biography, rudiments of grammar, observations on education, a course of lectures on oratory and criticism, an essay on the first principles of government, and on the nature of political, civil, and religious liberty, together with large numbers of works on metaphysical subjects and on theology.

But it is with the *chemical* aspect of Priestley's life that we are more particularly concerned at present. The anniversary about to be celebrated is that of a purely chemical discovery, and one which to us appears doubly important, first, from the great flood of light which it shed on the processes of combustion and of respiration, both animal and vegetable, aërial and aquatic; and secondly, from the powerful illustration which it affords of the value of a new method in scientific investigation. The purely practical results which in after years flowed from the discovery of oxygen, such, for example, as the oxy-hydrogen blowpipe, which enables large quantities of platinum and of the most refractory metals to be smelted with ease, are at present of minor interest. Is it not this over-anxious regard for "practical results" that has led to the complaints, too frequently made, about the decline of chemical research in England? The spirit of the old investigators of the school of Priestley, Cavendish, and Black seems to be forsaking us, and, with certain exceptions, our most efficient workers are devoting their time and energies to effecting permutations and combinations among the elements—in seeing in how many ways certain atoms of carbon, hydrogen, and oxygen can be combined, or in locating atoms to certain imaginary positions in space. It must not be for a moment supposed that we advocate the entire cessation of this kind of work—it is useful in its way as supplying facts, but by itself it is not sufficient to lead us to hope for any great advancement in our knowledge of chemical laws. The greatest advancements in chemistry have been the results of the application of *physical* discoveries—witness the vapour-density control for the formulæ of compounds and the atomic weights of the elementary gases; or the determination of specific heat as a means of controlling the atomic weight; or turn again to that great engine of modern research, the spectroscope, which has enabled us to extend our list of known elements, and which reduces

the chemistry of this globe and of suns infinitely remote to one common basis. So also is isomorphism an essentially physical phenomenon and one for the explanation of which we shall doubtless be hereafter indebted to physics. The Newton of chemistry may be looked for in the ranks of physicists. In the meantime let us only hope for "new methods" of research—let investigators seek for some method bearing the same relation to our chemistry that the "pneumatic chemistry" of Priestley did to that of his time.

ON TESTIMONIALISM

JUST now, there must be several scientific men asking themselves what can be the conceivable value of testimonials in determining the relative fitness of a number of candidates for any appointment of such importance as a Professorship of a most important branch of natural science in a great seat of learning.

It is not a point of any great difficulty to determine, to one's mental satisfaction, in what cases testimonials are of value—for they are sometimes most useful—and when they are worthless in comparison to other methods for testing the relative efficiency of different men.

Testimonials, or an examination, or the two combined, are no doubt necessary, when the post to be competed for is one, the qualities required for which are not capable of being exhibited to an electoral body by the competitors in any other way. For minor appointments, therefore, such as clerkships, smaller educational posts and the like, they are indispensable; as they are in cases where the intimacy of the relationship between the holder of the post and those he is placed above is close. But for appointments so honourable and responsible as the Professorship of Physiology in the University of Edinburgh, or that of Chemistry in the University of Glasgow, we cannot help thinking that testimonials are a farce. Candidates for such chairs are not youths; they must have had the opportunity of maturing their minds by careful training, during which time frequent opportunities must have occurred for them to take up some fresh branch of their subject and work it out independently, with some originality in the methods they employ. Their confidence in their methods and results ought to have been sufficient to make them publish them, and so expose them to the criticism of the scientific public, who do not generally take long to form a fairly correct estimate of the abilities of authors. If all candidates for important posts were compelled to rely for their election on their works alone as testimonials, we are sure that the electors would be less trammelled, and more in a position to make judicious selections.

By some it may be remarked that what is wanted in the cases above instanced is good teachers, and that if men with original power can be obtained at the same time, so much the better; this requirement makes the general ability of the professor a secondary consideration in comparison with his teaching powers. We are of opinion that this is a mistaken view of the subject. Very frequently the most talented followers of scientific inquiry are not such effective lecturers at first sight as their less-gifted colleagues; still, we never knew a case in which there was not a peculiar charm about the teaching of a master-mind that gives an impulse to study on the part of the student, producing in the long run more beneficial results than the routine discourses of a mere expositor of other people's work. Another thing is that the connection of great names with a seat of learning in itself gives a stimulus to younger workers, raising success in mental work to a position which it is not easy for it to attain, on account of the fact that its results have frequently no immediate practical bearing.

In one at least of the cases we are referring to it is unfortunate in some respects that the electors have no special interest in the science they have so great a power indirectly to advance. In consequence of this their knowledge of the respective merits of the candidates must be uncertain, and we do not think that it will be much increased by the showers of testimonials which it is evidently the intention of more than one of the candidates to submit. One candidate has sent broadcast a lithographed form, sometimes even to men his junior in position and age, courting testimonials. What possibly can be the value of the pound's weight of paper he will probably thus accumulate? He ought to remember that no number of shots from a smooth-bore gun will send a ball as far as a single one from an Armstrong, and on that principle reduce the number and endeavour to increase the quality of the testimonials he sends in; by which means he will save the adjectives as well as the temper of his acquaintances.

Another candidate sends us the printed list of his published works, and to that we see no particular objection. But appended to each is a selected series of reviews, from which all the unfavourable ones are carefully omitted. It is, no doubt, unpleasant to print adverse criticism, but how can the electors be expected to form a correct estimate of the value of the works reviewed, if those in their favour only are introduced? The reviews, as one-sided, had been much better omitted, or, if printed, had much better have been inserted without selection. It is this extreme mode of action thus adopted which has called our attention to the subject.

On the whole, we think that the electors for the Scotch Science Chairs have a by no means easy task before them, and we sincerely hope that in their selection they will lay stress on soundness of judgment and scientific thought rather than on quires of testimonials wrung out of acquaintances and friends, who would much rather have been otherwise employed than in putting pen to paper for the purpose.

Moreover, we are of opinion that not only should a man's researches be taken into account in making an appointment to any science chair, but also that no election should be made without taking the opinion of those competent to form an estimate of the value of these researches.

THE RAINFALL OF BARBADOS

Report upon the Rainfall of Barbados, and upon its influence on the Sugar Crops, 1847-1871. With two Supplements, 1873-74. By Governor Rawson, C.B.

THIS Report gives the result of observations made since 1847, at a large number of stations well distributed over the island. The total area of Barbados is 166 square miles; in 1847, only three stations had